SHIELDS

A Design of a Modern Foundry

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A DESIGN OF A MODERN FOUNDRY

BY

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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

CHARLES CULVER SHIELDS

ENTITLED A DESIGN OF A MODERN FOUNDRY

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

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A Design of a Modern Foundry.

I.- Introduction.

I have collected the majority of the material herein contained from the leading American Technical magazines and periodicals, endeavoring at the same time to select and bring out in this paper, the most widely approved practice in the foundry design of the present day.

Ironclad rules for the design of foundries cannot be laid down, because, in such design the ruling conditions, such as, locality, size, quality and quantity of castings, competition, and cost of building are the chief determining factors, and these conditions are more or less different in all foundries. The object of the design is mainly to show the arrangement of the different divisions of a foundry to obtain the best results. Having a few general conditions given as a basis from which to draw up the design, I have endeavored in this paper to show sufficient reasons for my various choices as to location and construction.

II.- General Conditions.

I have undertaken the design of a foundry to be located near Chicago, so that orders may be profitably filled and supplies economically obtained from that market. To fulfill these conditions there must be good railway facilities, and, where possible, water communication. The site on which the foundry is to be built should be high and level, as all the buildings should have the same floor

level, in order to facilitate the economical handling of castings an and supplies.

A rectangular building with a saw-tooth shaped roof such that the steep sloping side of the roof faces north, gives more efficient light to the foundry floor than other styles of construction; and , as this is a very desirable condition, I gave selected that type for my design. With the long wall running east and west, the light throughout the moulding room is better equalized than with the short side in that position. At this point the location of the railroad has to be considered in the design, because in the best practice the siding for loading and unloading is taken off parallel to the main line in order to obtain the most economical track layout. In the design shown, I have assumed that the railroad runs east and west past the north side of the foundry building. The south side of the building is thereby left free, and may be used in case extension becomes necessary, and therefore ample property south of the building should be available for such extension.

In the design of this foundry I have considered jobbing work in small grey iron castings, as the kind of product to be turned out, and have used that as a basis from which to work. Now in all foundries where the output depends upon the market, as in the case under consideration, some account must be taken of the fact that the kind of work to be done may vary within reasonable limits, and the construction, therefore, should be made to take care of such variation.

In the foundry herein designed cores are to be made for use in moulding, then after the moulds have been made they are

poured with iron from a cupola, and finally the castings, after sufficient cooling are forwarded to the cleaning department and there finished up for the shipping room. Moulding, melting, core making, and cleaning, therefore,are the most important of the operations to be provided for in the design. Besides these a pattern storage room will be necessary in which the patterns may be stored between the time of receiving from, and returning to, the customers. A woodshop, for flask making and pattern repairing, and a machine shop for general repairing must also be provided for. A toilet and locker room is also a necessary accessory in modern foundry design for the betterment of the foundry conditions, and benefit of the workmen. Supply storage space and gangway facilities must also be provided for to insure economy in moving materials between the various departments.

III.- Arrangement of Space.

The drawing enclosed is designed to give the best arrangement of buildings, and floor space possible under the conditions already laid down. As a basis to be used in proportioning, I have taken a rectangular bay 160 feet long, by 72 feet wide between wall centers, in which the moulding is to be done. The size and location of each of the other departments depends upon this assumption, and should be so arranged that the least amount of labor will be necessary in the handling of the product turned out, and the materials required.

In the moulding room, which occupies the main bay above considered, I have assumed the space occupied by the respective

branches to be about, one-half bench moulding, one quarter to three eighths machine moulding, and from one quarter down to one eighth floor moulding. For this class of machine and bench moulding the size of flasks usually ranges close to fourteen inches, and for convenient distribution of moulds for pouring, floors eight feet wide ranged along the north and south walls are used in this design. Each floor covers eight feet of wall space extending to a central gangway, and in the construction should not be cut up.

It may be necessary later to install a travelling crane over the machine and floor moulding sections, because of the size and weight of work to be done. The south wall being of temporary construction, the crane should be located along the north side of the bay supported by the north wall and central roof supports. For the above reason, I have divided the space along the south wall into floors for bench moulders, and that along the north wall into floor moulding , and machine moulding sections.

The space for floor moulding as apportioned in the design should be so arranged that in case the type of work warrants, it may be cut up into machine or bench moulding floors if desired. I have arranged for a three-foot central gangway in the design, which should be laid in such a way as to clear the central supports by at least one foot. The gangway is to be south of the center so that the north floors will be larger than the south floors as the amount of work done per floor bears that proportion. A six-foot gangway is shown in the design, leading directly from the cupola to the central gangway, and a continuation three feet in width extending through a south doorway out into the yard.

It is customary in modern practice to erect a separate cupola building, because a heavier construction than is used in other divisions of the foundry, has to be provided for in the design, in order to withstand the loads which may rest on the charging floor. I have located this building on the north side of the moulding room, near the center, as shown in the design. In this position it may be erected permanently, and be not only centrally located for the distribution of iron in the pouring-off process, but also situated in a convenient position to obtain supplies from the siding with the least amount of handling.

I have arranged for a locker-room in the cupola building to be located beneath the charging floor, as shown in the design. In the most modern practice it is customary to arrange locker- rooms in connection with foundries, so that it will be possible for the moulders , and workmen to go to and from their work dressed neatly. It is an established fact that such convenience improves the atmosphere in which the men work, and attracts the most desirable class of workmen. The locker-room in this location fills a space which otherwise would be more or less unoccupied, though the building has to be made larger than would otherwise be necessary, and its position is very convenient for the workmen. The part of the ground floor not necessary in the operation of the cupola, and for the elevator space is in the design partitioned off for the locker-room.

On the second or charging floor as shown in the design a space for the erection of the blowing machinery is partitioned off in order that it may be less exposed to dust and dirt. The elevator from the ground to the charging floor is located in the northeast corner of the cupola building so that it connects the storage bins,

through a doorway, directly with the charging floor.

In the case under consideration the most compact arrangement is to combine the cleaning, core-making, pattern storage and wood shop in one unit. I have done this by simply extending the foundry construction three more spans, or 48 feet, and dividing the space up as shown in the design.

The storage space necessary is an unknown quantity, depending upon the kind of work done and the time which is to intervene between casting and shipping. This section should be located close to the railroad siding, and as it does not require the light necessary in the other sections, I have designed the space so that the section of the east half on the north side can be used for the storage of castings. A clear space should be arranged for, through the center of this room for gangway purposes as shown in the design.

The core-room should have plenty of light, and should be so situated, that supplies can be readily obtained from the supply storage yard, and cores delivered to the foundry with the least amount of handling. I have therefore designed this room to occupy the space in the northwest corner as shown in the plan. In this way the lighting area is large, and by having a clear space from the east door to the store-room gangway supplies can be easily obtained from the outside yard and cores can be readily delivered to the moulders. This construction will make it necessary to have the core ovens outside of the building to lessen the danger of fire in the pattern storage as much as possible. I have therefore arranged to have the core ovens located as shown in the design, at the southwest end of the core-room, of separate outside construction, with

doors opening inward to allow for inside charging. This location also takes up the least possible window space, and is nearest to the distributing gangway. The core-makers' benches should be ranged along the remaining wall space, and core storage shelves set up along the partition between this room and the storage room.

I have located the cleaning department at the end of the structure farthest from the core-room in order to remove the noise of cleaning as far as possible from the same and at the same time have the benefit of the south light. It is also separated from the moulding room by a heavy wall, thus cutting off the noise in that direction. The rattler-room is partitioned off from the rest of the cleaning operations because of the resultant noise. The pickling and sand-blast rooms are also separate, because of the acid fumes given off in the former, and in order to keep the blast sand separated in the latter case. The rattlers, pickling troughs and sand blast should be arranged so that they can be charged and emptied in the most economical manner, which depends very largely on the design of the apparatus. The grinding and chipping room is partitioned off, as shown in the design, in order to be separated from the storing space, because of the dust and noise. The emery wheels should be ranged in a row along the north partition for the best distribution of floor space, thus leaving the remaining space for chipping. A gangway about five feet wide should be kept clear, with a central track as indicated in the design, so that the castings can be easily delivered from the moulding room to the various cleaning departments.

The light in the cleaning and storing sections, and in the

core-room will be sufficient without the use of the roof light, and a twelve-foot ceiling over all will be high enough with good ventilation, and with dust removing devices installed. The height of the main foundry walls should be at least 20 feet according to the best practice in cases where crane installation is contemplated. Using a twelve-foot ceiling on the lower floor, about seven feet will be left between the upper floor and the roof truss work. I have designed the upper floor space so that the wood working shop will be located beneath the north roof gable; and as the gable peak is to be at least eight feet above the wall, this will leave plenty of air space above the floor, and the light in the room will be ample. The work benches should be ranged along the north wall for the best results, and the machinery located about the room in the most efficient manner.

I have herein partitioned off the remaining space on this floor for pattern storage. Particular precaution should be taken to provide against fire in this section. The shelving should be erected to fill the space in the most economical manner, and at the same time leave sufficient aisle space so that the patterns can be readily handled. In the design I have shown the layout of the main aisles, and the general shelf location, but the latter may be cut up as is deemed necessary with reference to the sizes of the patterns stored. A light elevator will be necessary to connect the ground floor with the wood shop and pattern storage. In the design I have located this elevator in the southeast corner of the wood shop, in order to be centrally located in the most available section, and close to the storage room gangway on the first floor.

The power to be used in the foundry operations and light-

ing may either be purchased from an electric power station, when available, or developed in a power plant installed on the foundry site. In this design I have considered the latter case, the power plant being located as shown - west of the foundry building and close to the siding so that the fuel supply can be best obtained from the same. The size of the plant and its exact location and construction cannot be accurately determined until the power necessary and the units for its development are known. Therefore, in this design I have only considered its location with reference to the main building and the siding.

In the design I have arranged for a repair shop and a supply room in connection with this building. These are located on the east side of the building in order to be nearest to the foundry building, and are separated by a hallway leading into the engine room. The boiler room is located west of the engine room so that fuel can be most conveniently handled.

The size of the office building is a very hard problem to solve without a thorough knowledge of the business end of the foundry, and I have herein only considered the most desirable location for the same. I have in the design located the building on the north side of the siding opposite the cupola room and a little west so that its central location will overlook the length of the foundry buildings and yards, and be in a position convenient to the moulding and shipping rooms.

The space about twenty feet south of the moulding room should be divided into sections for the storage of flasks, and a lean-to construction may be erected as a protection against the weather.

I have arranged in the design to have the space nearest the cupola on the east side divided into sections for pig iron, scrap, and coke, respectively, the coke to be stored in a closed shed for weather protection, while the other two are not enough injured by the same to necessitate their being stored.

The moulding sand and other moulding and cupola materials are to be stored in sheds located east of the coke and iron storage, and along the railroad siding.

West of the cupola room covered bins are located in which core room, pickle room, and sand blast materials are stored. These should be in sheds of temporary construction in order to allow for expansion of the shipping room.

In the design I have located the yard gangways as shown to give the best efficiency in the moving of materials from the yard storage to the sections in which they are needed. I have designed three-foot gangways laid with five-foot clearance to allow sufficient room for the cars used as carriers.

I have designed the shipping room so that its south wall is centrally located with regard to the storage room, and set far enough from the main building so that the light will be unobstructed. A long narrow structure such as shown in the design makes a very convenient construction. I have left the details of the building indefinite as its size and arrangement depend largely upon the product of the foundry.

IV.- Construction of the Moulding Room.

As the product of the foundry under consideration is liable to vary, within reasonable limits, a floor which can be

readily replaced without undo expense, and at the same time be suitable, will be the best construction. A six-inch yellow clay floor laid on a compact bed of cinders fills the first requirement, and its first cost is much less tham other types. As such a floor is very yielding to the moulders' feet, can be easily repaired, and has the desirable property of retaining a small amount of moisture, I have selected it for this design.

The stall constructions between the bench moulding floors should be of temporary wooden construction at the start, but in case a permanent distribution of the area is made, a light re-inforced concrete stall is the most suitable for the requirements.

The use of sulky ladles in the distribution of iron over the foundry, and the necessity for smooth motion in the distribution of cores, considered along with the lack of crane and trolley systems, necessitate the use of narrow gauge track in the gangways. I have therefore selected a track of 24-inch gauge to be built into a cement gangway 36 inches wide. This gangway is to be built with a level one inch above the clay floor, and extend the length of the building as shown. The gangway from the cupola to the central gangway should be of six-foot width, widening out at the cupola as shown in the design. A 24-inch gauge track in this gangway should be connected to the central track at their point of intersection by means of a turntable. A gangway of the same construction should be laid in such a way as to connect the central turntable with the south yard, as shown in the design.

This concrete construction is very durable and clean, and gives satisfactory results because of the extensive use of

wheelbarrows in this class of work, and the necessity for a level gangway surface.

I have selected brick walls in my design as they are used to the greatest extent in the most approved practice, and their design should be of sufficient strength to meet the conditions imposed by the surroundings. In the design shown the centers of the wall columns are erected sixteen feet apart in order to rise at floor divisions, and leave space for efficient window lighting between columns. The same spacing should also be used in the erection of the roof supports, so that the moulding floors will not be unduly cut up.

About 1,000 square feet of lighting area should be provided for in the design of the north and south walls of the main bay, and about 200 square feet in the design of the east wall. These windows should be located between wall columns for the best distribution of lighting, and no load should rest on the frames. One-third of the side wall and one-half of the end wall window areas should be made adjustable for use in ventilating.

In this design I have arranged for a possible travelling crane installation along the north half of the building, so that one of about 30-foot span, and not higher than two tons capacity, may be installed after the foundry is in use if it is deemed necessary. The central supports and north walls of the building should be re-inforced in such a way that this extra load can be supported in case the crane is added. The second and fourth central supports from the east wall should be strong enough to carry jib cranes of one ton capacity and fourteen-foot radius, which can be installed if the work done should warrant.

At the east, west and south sides of the foundry building double doors fourteen feet wide by ten feet high should be provided in each case, and one of the halves of each door should contain a door three feet wide by seven feet high for the convenience of the workmen. The south wall of the foundry should be of temporary construction so that in case larger area is necessary expansion can take place in that direction by the addition of another saw-tooth bay.

In this design I have selected a saw-tooth roof as the most desirable construction to fulfill, and fit the conditions imposed. Besides its advantage in lighting area over other types, another bay can be added in case of expansion without any space having to be left between buildings for lighting purposes, as the roof light is ample in this style of building. A slow burning roof construction made of three-inch flooring is to be used having an outside covering of paper with a graveled tar surface. This has the advantage of low first cost, coupled with low cost of repairing, and fair length of life, and is very largely used in modern construction. The roof is to be re-inforced by the use of steel truss work which in turn is supported by the walls and central columns from the floor. The north side of each saw-tooth length should be almost entirely glass designed to contain about 1200 square feet of lighting surface. This glass should be cast plate with wire mesh re-inforcement, and should be laid in the roof in the best manner for water shedding and stability. The south side of the roof should have a gradual slope, and be of the plain roof construction, while the north side should be almost vertical, about 80 degrees with the horizontal. The north light is used in saw-tooth construction so

that the direct rays of the sun with the resultant lights and shadows are eliminated, and a well diffused vertical light obtained.

The top ridge of each saw-tooth is to have a monitor running its whole length so that at the time of taking off a heat the gas and smoke can escape through a ventilating arrangement. A row of hinged windows on either side of the monitor which can be simultaneously operated from the foundry floor, by a suitable mechanism, is a commonly used device for ventilating.

V.- Construction of the Cupola Building.

The main floor in the cupola room should be of the same construction as the foundry floor. The cupola and elevator foundations are to be made of concrete, the former being low enough for about a four-inch covering of sand and clay, as a protection against direct contact with hot iron. The floor of the locker room should preferably be of concrete, as such a floor can be easily cared for, is very serviceable, and has a very good appearance.

I have selected a re-inforced concrete floor as the construction best suited to the work done on the charging floor. The section of this floor where the charging is to be done, and the charge stored should be covered with thin iron plates because of the heavy wear due to the handling of the pig iron and scrap. The blower section is to be left uncovered, and the machines are to be set up on the concrete floor.

The roof of the cupola building should be of the flat type, designed with standard slope for good water-shedding, and should be of the same construction as the foundry roof.

A partition should be erected as shown in the design, so that the blower room is separated from the charging floor thereby lessening the exposure of the machinery, therein contained, to the dust and dirt of that floor. A partition must be erected between the locker room and cupola room as shown in the design, and a swinging door, eight feet high by about three feet wide, hung at its south end connecting the locker room with the foundry along the gangway as shown.

The brick walls of the cupola room must be made heavier, and probably will need to be re-inforced, because of the heavy load that will have to be carried, and a load of at least two days' cupola supply - about 30 tons - should be allowed for in the design. The size of cupola necesary can best be determined by the foundry foreman and those persons most familiar with the work to be done, as considerable experience is necessary for intelligent selection. In the design a 72-inch cupola will be ample for the work and if it is found to be too large for the work at first the size can be reduced by an extra inside course of fire brick.

I have allowed for the erection of a second cupola eight or ten feet west of the one shown in the design, though it will necessitate a change in the locker room partition. I have used sixteen feet as the height of the charging floor above the foundry level, it being the most common dimension used in work of this description. A shaft should be erected for an elevator, having a platform five by eight feet, to be used for raising the charge to the cupola platform, and located as shown in the design. Columns for supporting the charging floor may be erected at convenient intervals. The north wall of the foundry should be re-inforced, at the section where the cupola building joins, so that it will also

serve as the south wall of the cupola building. The door leading from the elevator as shown in the design should be about eight feet high by ten feet wide and should be hung on pulleys so that it can slide along the east outside wall.

An entrance four feet wide by seven feet high is also provided to the locker room. A north entrance to the locker room, and about 150 square feet of window space should be provided for. A flight of stairs, as shown in the design, should be erected from the moulding floor to the cupola charging room for the use of the workmen.

VI.- Construction of West Bay.

The construction of the bay in which the cleaning, storing and core making departments are located is similar to the main moulding bay. The upper floor is to be supported by the central columns and any extra supports necessary may be placed in the partitions, and in that way avoid cutting up the floor space. The partitions dividing the rattler, pickle, sand blast, cleaning, and core making rooms from the store room should be of temporary brick construction, so that in case of expansion the space can be divided again without undo waste.

The ground floor of this bay is to be of concrete laid on a level with the moulding room gangway. Concrete is used as the work to be done will be heavy, and it makes a very strong, durable floor that can easily be kept clean, and the danger of fire from this source is eliminated. These advantages outweigh the consideration of first cost. The narrow gauge track from the moulding room

is to be continued to a turntable, the center of which is about twelve feet from the east wall. A track is to lead from this turntable south to a turntable with its center four feet from the rattler room partition, and a track from there leads west along the cleaning sections. A track should also connect the turntable in the center of the store room with the core room, and another with the yard and shipping room through a north door, as shown in the design. With this track layout, and having a clear space five or six feet wide for gangway, the materials and castings can be very conveniently handled.

Two core ovens of brick construction are designed to be built against the west wall of the core room as shown in the design. For the type of core making to be done a large oven about ten by twelve feet will bake all the various cores necessary, and a small one about six by four will serve in case a hurried order is to be filled, or in case there are not cores enough to be baked to warrant the use of the larger oven. The height of the large oven should be about six and one-half feet, and the smaller one about four feet. The large oven is to be fitted with double tracks of 24-inch gauge so that two loaded cars can be inclosed in it at once, while the smaller one is made up of moveable shelves. The firebox of the larger should be located below the floor line and that of the smaller in the rear end. The track from the turntable to the core room should be located in such a position that the cars may be run onto the foundry gangway directly from the core oven, thus saving the cost of extra handling.

The wood shop benches for the workmen are to be built so

that they will range along the north wall. In that way there will be plenty of space above them for ventilation as the ridge of the roof will be at least eight feet above the wall and therefore at least fifteen feet above the floor level. The roof light will be sufficient for the wood shop processes. There should be a light partition between the wood shop and pattern storage as a protection against dust and dirt.

The shelves in the pattern storage should be made large enough to store the different sized patterns, and aisles should be arranged for between the shelves, large enough for easy passage of patterns and workmen. Wood shelving is the cheapest, and though not fire-proof is the best for temporary construction to be used until more accurate data is obtained as regards the description of patterns to be stored. In case a permanent construction is desired one of concrete, iron, and zinc or some other type of fire-proof structure is the best.

The floor is of permanent construction, and should therefore be durable, as well as fire-proof if possible. The loads are comparatively light, and a tile floor reinforced and laid in cement is very satisfactory and cheaper than solid concrete, as well as lighter. However, the section on which the wood working machinery is to be erected should be constructed of reinforced concrete.

An elevator should be erected on the east side of the store room to connect the ground floor with the floor above, as shown in the design. A light elevator run by hydrant water power will carry all the loads, and the platform should be five by eight feet, to carry flasks, and patterns conveniently. A stairway

should also be erected along the core room partition to the wood shop, for use while the elevator is not running or busy.

The office and power plant buildings are to be built preferably of brick with roofs of slow burning construction the same as the main building.

In the office building wood floors are the preferred construction, mainly because they have a very yielding property which eases the feet of those working there. They are much cheaper than cement in first cost and the stresses on them will be comparatively light. Particular attention should be paid to the lighting, and a large area should be fitted with windows. A special room should be partitioned off in this building for a laboratory for testing materials, as chemical and physical tests of foundry materials are a necessity in an up-to-date foundry.

The power plant should be built of brick with concrete floors throughout - the walls and roof to be built as above stated and the stack may be of brick or concrete, depending on the first cost. The cement floor is here specified because the stresses are great, the floor can be better cared for, and the fire danger is less than with other constructions, and the machines should have a solid concrete foundation.

VII.- Heating and Ventilating.

The buildings should be heated, and receive ventilation from the same system, as in the most modern construction. The direct steam radiation, though in many cases considered very satisfactory, owing to the difficulty of location and the space occupied

by the piping is unsatisfactory. In the direct system of heating, air is forced through a steam coil made up of small steam pipes by a fan, and is circulated to the various sections through a system of tubing. The air should be distributed in the building so as to eliminate as much as possible the effect of the rising current of heated air, and secure a perfect diffusion of heat as near the floor line as possible. With the fan system the loss by radiation through the walls is less and the distribution of heat more even. The air in the building should be used over, and over again to lessen the amount of heating necessary.

During the time of taking off a heat arrangements should be made so that the smoke and gas laden air is not returned to be re-used but should be allowed to escape through the roof monitors. During the period of moulding the air should be changed about every fifteen or twenty minutes for good ventilation.

The cupola building and the sections at the west end of the foundry building are heated and ventilated by a branch of the same system. However, air from the pickling room should not be returned to the fan, because it is too impure for re-use. The tumbling barrels, grinding wheels, and sand bath should be provided with an exhausting system, so that the dust and dirt cleaned from the castings will be carried directly outside by exhaust tubes. This system will insure good ventilation in the cleaning sections, thereby greatly improving working conditions.

The office building and power plant should be heated by direct radiation, as the system is clean and economical. The dust and air from the foundry is therefore not re-used in these departments.

VIII.- Power and Lighting.

In the case under consideration the power is developed in the power house, and electrical distribution is the most economical though the first cost may be higher. The cupola blower, the wood working machinery, the tumblers, the cleaning room exhausters, the emery wheels, and other smaller machines should be run by motors. The cleaning room, core room, foundry, and possibly the cupola elevator will need compressed air in connection, and therefore an air compressor will be necessary. The air compressor and pumping engines should preferably be located in the power house. The foundry buildings should be supplied with water from the city mains or by pumps for fire protection and other purposes.

The walls of the foundry building should be painted white, as white walls are a material aid to efficient lighting. The windows should also be kept clean for a like reason. The most approved system of lighting in foundry practice is electric, and as electricity must be used in this foundry the incandescent and arc lighting is the best. These lights should be distributed in the best manner possible so that on dark days, or in winter months when the days are short, the light will be good enough for the finest work done in the foundry. Drops with hand lamps attached should be supplied for each moulder so that the lamps can be used as portable light.

IX.- Installation Details.

The foundry foreman's wishes should be given a great deal of weight in deciding on the equipment and its exact location, inasmuch as he is the one who has to get the direct results

from the use of the same, and therefore should be in a position to know what is desired for the type of work to be accomplished.

In the moulding room, the size and design of the benches, the type of moulding machines, the design and location of water troughs, and other minor details are largely up to the foreman for settlement. In the cupola room, the size of the cupola, blowers, and elevator depend upon the amount of iron to be poured off at one time.

The rattlers, pickling troughs, emery wheels, compressed air chisels necessary and their size and definite location depend largely upon the work turned out, as to quantity and size. In the core room the design of the core oven cars, the benches, and the shelving will depend on the character of the output. The wood shop should be equipped with the following: a band saw, circular saw, planing table, wood lathe, trimmer, and benches. The types of the equipment depend largely on the work to be done, and it should be located for the greatest economy of space.

The use of special devices in the foundry and its dependent operations must also be considered and where a time and labor saving device can be economically added, the installation should be made. However, care should be taken in the selection of such devices, as such experimenting on an extensive scale is liable to be disastrous.

X.- Estimate of Cost.

I have herein estimated the cost of the building erection, and the installation of the foundry designed. I have not estimated the cost of the heating and ventilating system, or of the power plant, office and shipping buildings, with their equipment.

Cost of Moulding Bay	
@ 5-1/2¢ per cu. ft. ----------	$16,157.00
Cost of Cupola Room and West End	
@ 13¢ per cu. ft. ----------	14,295.00
Building Cost ----------	$30,452.00

Moulding Division.

Turntables and Track ----------	$800.00
10 Moulding Machines ----------	600.00
Flasks ----------	600.00
Benches ----------	300.00
Ladles, etc. ----------	1,000.00
Sheds, etc. ----------	600.00
Total ----------	$3,900.00

Cupola Division.

Cupola (complete)	$800.00
Blower	300.00
Motor	250.00
Elevator	200.00
Scales	200.00
Lockers and Toilets	300.00
Total	$2,050.00

Cleaning.

Tumbling Barrels - 2(24"x 48")	$240.00
" " - 1(36"x 60")	240.00
Motor	250.00
Pickling Tubs	200.00
Sand Blast	75.00
Core Oven (small)	100.00
" " (large)	250.00
Grinding	60.00
Motor	175.00
Total	$1,590.00

Wood Shop.

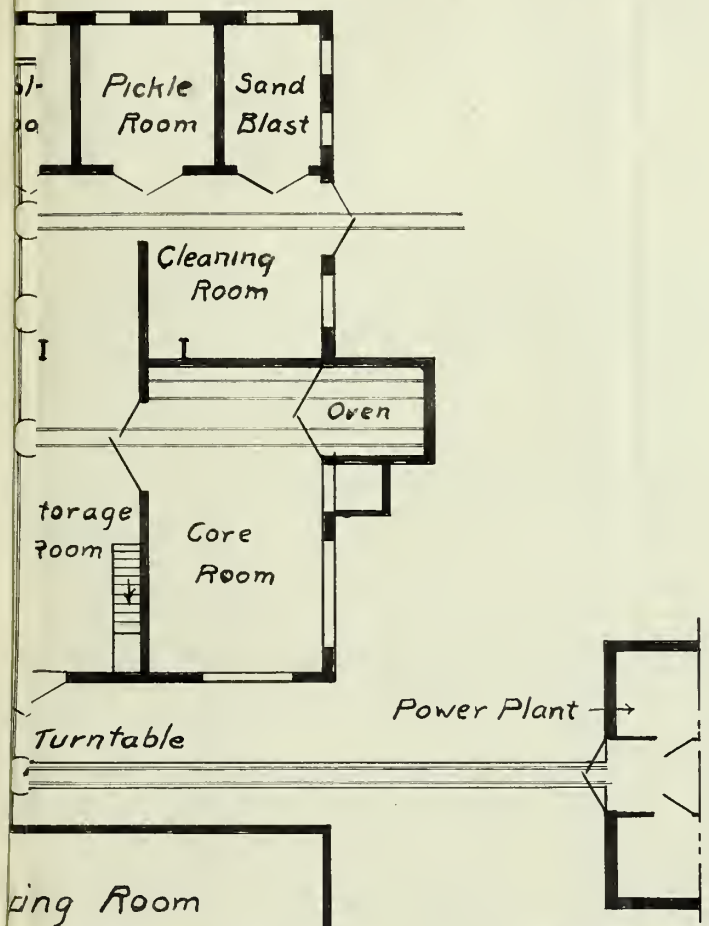
Elevator	$100.00
Band Saw	150.00
Wood Lathe	125.00
Circular Saw	150.00
Planer	175.00
Trimmer	75.00
Motor	250.00
Benches , etc.	100.00
Total	$1,125.00

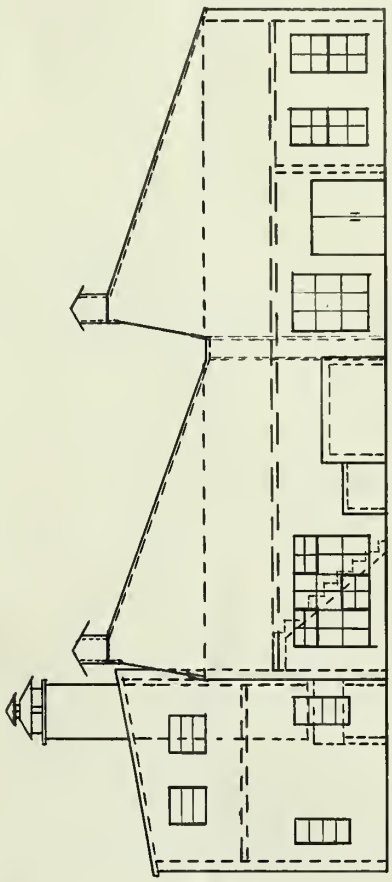
Pattern Storage.

Shelving, etc.	$800.00

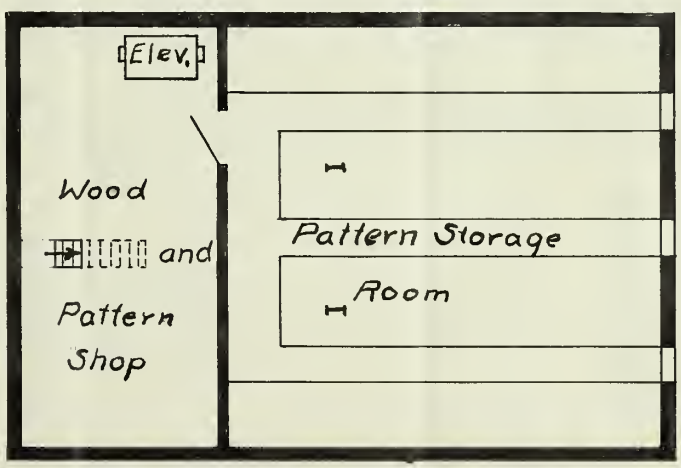
Summary.

Building Cost	$30,452.00
Moulding Division	3,900.00
Cupola Division	2,050.00
Cleaning	1,590.00
Wood Shop	1,125.00
Pattern Storage	800.00
Total Foundry Cost	$39,917.00





END ELEVATION



PLAN OF SECOND FLOOR

Flask Storage Yard

Stalls

Bench Moulding Floors

Gangway

Floor Moulding Floors

Machine Moulding Floors

Tumbler Room

Pickle Room

Sand Blast

Cleaning Room

Oven

Storage Room

Core Room

Elev.

Power Plant

Turntable

Cupola

Locker Room

Narrow Gauge Track

Scales

Elev.

Storage Bins

Sand

Coke

Scrap

Pig Iron

Storage Bins

Shipping Room

Railroad Siding

Office Building

PLAN OF FOUNDRY BUILDING AND GROUNDS

END ELEVATION

Cupola

Blower Room

Charging Room

Elev.

PLAN OF CHARGING FLOOR

Elev.

Wood and Pattern Shop

Pattern Storage Room

PLAN OF SECOND FLOOR